

Before the Ministry for the Environment

in the matter of: the Resource Management Act 1991

and

in the matter of: an application for a Water Conservation Order on the Hurunui River pursuant to section 199 of the Act

Brief of evidence of Nicholas Charles Eldred

Dated: 31 March 2009

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BRIEF OF EVIDENCE OF NICHOLAS CHARLES ELDRED

INTRODUCTION

- 1 My full name is Nicholas Charles Eldred.
- 2 I am the Water Infrastructure Development Manager for Meridian Energy Limited (*Meridian*). I have worked in the Growth and Development Directorate of Meridian for 5 years and my team and I are responsible for identifying, securing and developing new hydro electric power schemes, irrigation projects and other water related infrastructure, including marine energy opportunities that may become available in the future.
- 3 I am authorised to give this evidence on Meridian's behalf.
- 4 I have the following qualifications:
 - 4.1 Bachelor of Science (1987, University of London, Queen Mary College, Engineering Geomorphology (Hons));
 - 4.2 Master of Science (1988, University of London, Queen Mary College, Geomaterials).
- 5 The majority of my 21 years of professional experience has been involved in the design and construction of major infrastructure projects including several tunnels and hydro electric power schemes. Prior to joining Meridian in 2004 I worked as a consultant engineering geologist in the UK, New Zealand and many other countries. My experience also includes the investigation of groundwater issues for both engineering and environmental projects and I have been involved with numerous resource consent applications since moving to New Zealand in 1992.
- 6 Other roles I have fulfilled at Meridian include responsibility for investigating and identifying hydro and geothermal development opportunities and as the project manager for the North Bank Tunnel Project; an 1100 to 1400 GWh hydro proposal on the lower Waitaki River. This project is currently progressing through the resource consent process.
- 7 Examples of some of my other experience specifically relevant to hydro development includes: investigations and consenting of a hydro dam on the Mokihinui River approximately 40km north of Westport; tunnel design and construction supervision of the Second

Manapouri Tailrace Tunnel; construction supervision of the Matahina Hydro Electric Scheme dam reconstruction project; tunnel design for the Channel Tunnel, Jubilee Underground railway line extension and London water supply ring main in the UK; and road and rail tunnels in Hong Kong, Spain, Australia and Singapore.

8 Immediately prior to joining Meridian I was involved as a Project Manager at URS Ltd in both the engineering geology and groundwater aspects of Project Aqua and was responsible for the design and supervision of the geotechnical investigations for the project.

9 In preparing my evidence I have reviewed:

9.1 the *Application for a Water Conservation Order on the Hurunui River* lodged by the New Zealand and North Canterbury Fish and Game Councils and the New Zealand Recreational Canoeing Association in August 2007; and

9.2 the submissions of those parties Meridian has further submitted on in relation to above application.

SCOPE OF EVIDENCE

10 In this evidence I outline:

10.1 Meridian's renewable generation portfolio and commitment to renewable generation;

10.2 The nature of hydro-generation and the combination of natural and physical resources that need to come together to enable a viable renewable energy project;

10.3 Meridian's relationship with Ngai Tahu Forest Estate Limited and opportunities for development on the lower Hurunui River;

10.4 How the effects of hydro-electricity schemes can be mitigated and the ability to protect and maintain environmental values through the design and construction of an appropriate scheme; and

10.5 Concerns about the WCO application for the Hurunui River (in particular those submissions seeking to extend the extent of the application) and in particular the need for flexibility in intake design and fish exclusion.

MERIDIAN AND RENEWABLE GENERATION

- 11 Meridian is a limited liability company wholly owned by the New Zealand Government. It is one of three companies formed from the split of ECNZ on 1 April 1999.
- 12 Meridian's Statement of Corporate Intent states that:
- "Meridian Energy's nature and scope of activities is the generation of electricity (including the ownership and operation of related assets), the management of water related infrastructure, and the marketing, trading and retailing of energy and wider complementary products, solutions and services, primarily within New Zealand."*
- 13 Meridian is the single largest generator of electricity in New Zealand. Its hydro and wind generation and storage capacity accounts for approximately 30% of New Zealand's electricity generating capacity and 76% of New Zealand's hydro storage capacity.
- 14 When Meridian was formed on 1 April 1999 the assets associated with the Waitaki Power Scheme, the Manapouri Power Scheme and the Brooklyn Wind Turbine were acquired. Meridian is currently nearing completion of Project West Wind near Wellington, a wind farm proposal comprising 62 turbines of 2.3 MW each. Meridian completed the 90 MW Te Apiti Wind Farm in the Manawatu in 2004 and the 58 MW White Hill Wind Farm in Southland in 2007.
- 15 As part of its ongoing operations Meridian is continually investigating and pursuing options for new renewable generation capacity and is investigating a number of sites that have potential for wind or hydro development.
- Meridian's commitment to renewable generation**
- 16 On 22 November 2004 Meridian announced its commitment to generate electricity solely from renewable sources in the future.
- 17 This decision was not made lightly, however Meridian has chosen this path because it considers it is the right thing commercially for its business and because it is an environmentally responsible choice for New Zealand now, and in the future.
- 18 Meridian's commitment to renewable electricity generation is also aligned with Government policy. In 2007 the Government released the New Zealand Energy Strategy to 2050 which emphasises the use of renewable energy resources to deliver a sustainable low emissions energy supply to New Zealand. **Mr Brown** will discuss this in his evidence.
- 19 Meridian has a proven track record in the development and operation of energy projects both in New Zealand and overseas. It

also has a proven record in the development and operation of projects within sensitive areas. This includes the World Heritage listed Fiordland National Park (construction of the 10 km long Manapouri Second Tailrace Tunnel), and an exemplary record of environmental compliance in new projects such as the Te Apiti Wind Farm and White Hill Wind Farm.

- 20 In all the projects it is involved in Meridian has adopted a “best practice” philosophy. The Manapouri Second Tailrace Tunnel project - New Zealand’s largest energy efficiency project to date - was completed to the highest environmental standards and was a finalist in the 2002 Financial Times Global Energy Awards.
- 21 For Meridian to either undertake upgrades or to have a mandate to develop new assets on green field sites (such as might be possible in locations such as the Hurunui River), Meridian considers it essential that it is first able to demonstrate that our existing plant and resources are being used in a sustainable manner.
- 22 Meridian’s programme of existing and future work ensures that the existing system is operating as efficiently as possible and generation capacity is optimised. Planned, ongoing and completed works include:
- 22.1 Turbine replacement of the Aviemore Power Station resulting in a 5% gain in efficiency for this asset (completed in 2000);
- 22.2 The Second Manapouri Tailrace Tunnel project, completed in 2001, increased the annual energy output of New Zealand’s largest hydro station by over 10%, and was followed by turbine replacement that increased output by a further 3%;
- 22.3 Benmore Power Station is currently undergoing a major refurbishment that is likely to result in a 3% efficiency gain and an approximate increase in energy output of 65 GWh per annum; and
- 22.4 Proposed future refurbishment of the Tekapo A, Tekapo B, Ohau A and Ohau B and Ohau C Power Stations to maintain the existing assets plus realise potential efficiency and energy gains.
- 23 In addition we are also actively seeking consents for further hydro-generation assets. This includes:
- 23.1 The North Bank Tunnel scheme located on the lower Waitaki River. Currently this project is working through the resource consent process (consents granted but subject to appeal). If consented and built it would result in a net gain of between 1,100 and 1,400 GWh per year of energy. This would be an

increase in generation on the Waitaki Power Scheme of between 13% and 18% based on an average of 8,000 GWh per annum being generated from the existing scheme;

- 23.2 The Manapouri Tailrace Amended Discharge Project proposes to increase the maximum tailrace discharge limit for the Manapouri Power Scheme from 510 to 550 cumecs. This does not require any alteration to the existing power station infrastructure but simply allows better utilisation of the asset following completion of the second tailrace tunnel in 2001 and the turbine replacement in 2007. The proposal will further increase generation by 89 GWh per annum on average; and
- 23.3 The Mokihinui Hydro Proposal for the construction of a hydro dam and power station in the Buller District. The scheme would produce between 360 and 410 gigawatt hours (GWh) per year of renewable electricity generation.
- 24 This programme of existing and future works demonstrates how Meridian has, and will continue to, focus on maximising electricity generation from its existing assets and other resources. Where possible, we have focused on investigating and developing enhancements to these assets on existing river and lake systems which are already modified, before considering new developments such as those that might be possible on the Mokihinui and lower Hurunui Rivers.

THE NATURE OF RENEWABLE GENERATION

- 25 Meridian's economic analysis suggests that the best of New Zealand's renewable generation opportunities are also the lowest-cost new electricity options at this time. New Zealand has benefited from half a century of low-cost electricity from the nation's hydro stations.
- 26 Around 15 new hydro-generation proposals have been put forward by both established participants and new entrants to the industry as electricity supply conditions have tightened. These proposals are at various stages, from initial pre-feasibility proposals through to committed projects.
- 27 There have also been public announcements relating to over 30 wind farm proposals at different stages of evaluation, planning or construction. There are similarly a further 8 geothermal and 12 natural gas, coal, cogeneration or landfill gas options at various stages. These projects have a combined potential production of over 25,000 GWh.

- 28 In addition to these projects, there are other options available, such as those on the lower Hurunui River which are not yet, at least in the form of an application, in the public arena.
- 29 However, it is important to emphasise that many of the apparently possible projects are unlikely to proceed - at least in the short to medium term due to a number of factors including project economics, technology, transmission and consentability.
- 30 Given this, it is Meridian's view that quality proposals such as that which might be possible on the lower Hurunui River are considerably more limited. I also consider that the opportunities for experienced and credible developers with strong track records are comparatively limited, making any opportunity to sustainably meet new demand critical to our future growth.
- 31 In terms of the Hurunui River, I also note it has long been identified as a potential hydro development opportunity and is referenced in several public documents including the "*Waters of National Importance – Identification of Potential Hydroelectric Resources*" (2004) by East Harbour Management Services for the Ministry for Economic Development.

Economics of new generation

- 32 The two key issues for new generation options are the availability and price of fuel sources, and consentability. Of the projects that can be consented, from an economic perspective the projects that should proceed are those with the lowest cost.
- 33 However, it is also important that we do not lose perspective of the other generation opportunities potentially available to meet future and ongoing demand. In short:
- 33.1 Unless there is a large gas discovery, current contract gas prices make gas fired generation more expensive than many renewable projects. Such a gas discovery is uncertain as is the future gas price for any new find. In addition, thermal generation faces the prospect of an additional cost of carbon emissions.
- 33.2 The importation of liquefied natural gas (LNG) is under investigation by some parties. However, at current delivered prices it is very likely to be uneconomic. In addition, this option also faces the issues associated with the Government's renewable energy targets and has, in my opinion, the significant disadvantage of further exposing New Zealand to global energy market prices.

- 33.3 Most coal options, because of their infrastructural requirements, are very expensive and, as with gas, face additional carbon emission costs.
- 33.4 Geothermal development is economic in proven brownfield sites but these are limited in their potential output. Much of the large scale growth will depend on development in still to be proven green field sites. However, conventional geothermal resources are almost exclusively located in the central North Island and will not contribute meaningfully to meeting demand growth in the South Island. Nonetheless, geothermal will be an important part of the new generation mix.
- 33.5 Wind energy is a corner stone of Meridian's future energy development plans and is expected to supply an increasing proportion of New Zealand's energy over the next few decades. The uptake of wind is constrained in some power systems because it is an intermittent source of energy (which means that generation is entirely dependent on the instantaneous wind speed at the point of generation). However, in New Zealand we are able to develop significant amounts of wind energy with low system costs because of the existing flexible hydro plant. Hydro development is important to allow the ongoing development of wind resources in the future.
- 33.6 Marine energy is still at a very early phase of its development cycle. For it to become a feasible option considerable time is needed to establish the technologies and the necessary understanding of our marine resources. Marine energy will not make a significant contribution to the 2025 90% renewables target.
- 33.7 Biomass, because of its very limited output, and solar energy, because of its high costs, are unlikely to make any significant contribution to new generation in the near future.
- 33.8 Aside from its prohibited status under New Zealand legislation, there are major economic and technical issues that render nuclear power an unlikely option.
- 34 Overall, of the realistically available generation options (hydro, wind and geothermal), existing and new hydro is the most important to maintain flexibility and base-supply in the electricity system. The intermittent nature of wind generation means that as our wind portfolio grows operation of the power system will increasingly rely on hydro. Equally, geothermal energy, although important, cannot contribute meaningfully to meeting demand growth in the South Island.

Hydro generation

- 35 In 2004 the Energy Efficiency and Conservation Authority (*EECA*) estimated that New Zealand has further potential in hydro development of 2,205 MW and 10,900 GWh with a high to medium confidence (in terms of consentability and cost) of being developed. A number of sites have been identified on the east coast of the South Island, including schemes on the Hurunui River.
- 36 My team and I have been investigating and identifying realisable hydro power options in New Zealand since 2004. The conclusion we have reached is that only a proportion of this potential New Zealand hydro power development is achievable. There are a range of reasons for this and include: restricted access to potential sites including Water Conservation Orders, or other forms of protection and management by the Department of Conservation; existing allocation of water to other users; unacceptable environmental impacts; accessibility issues for construction; absence of transmission; technology issues; and scheme economics.
- 37 Any scheme that can address the above criteria then needs to be more closely examined to ensure that the following issues can be addressed:
- 37.1 Engineering feasibility and likely construction costs and scheme economics;
 - 37.2 Legal and regulatory issues e.g. RMA, relevant planning and policy documents;
 - 37.3 An initial review of environmental and social issues;
 - 37.4 Where diversion schemes are being considered (either canals or tunnels), the amount of water that could be diverted from the river;
 - 37.5 Where impoundments are being considered the likely impact on ecological values and existing infrastructure; and
 - 37.6 Potentially affected parties.
- 38 In summary, only a small proportion of all possible schemes will meet the above requirements. Work completed by Ngai Tahu Holdings and Meridian indicates that a hydro scheme on the lower Hurunui River and located in the vicinity of Balmoral Forest is likely to meet these criteria. Therefore, I urge the panel to be very careful when making decisions that may unnecessarily preclude this, or similar, developments on the lower river.

THE LOWER HURUNUI HYDRO OPPORTUNITY AND ARRANGMENTS WITH NGAI TAHU

- 39 I will now describe the possible hydro development and Meridian and Ngai Tahu Forest Estates Limited's ('NTFE') relationship.
- 40 NTFE owns 8596 hectares of land adjoining and adjacent to the Hurunui River below its confluence with the Mandamus River.
- 41 This is primarily used for the forestry operation known as "Balmoral Forest". The forest falls in elevation at a relatively constant rate from west to east, parallel with the river.
- 42 NTFE has already undertaken pre-feasibility studies that have identified a potential hydro development associated with the Balmoral Forest and Hurunui River.
- 43 NTFE and Meridian have entered into an arrangement where they have agreed to jointly investigate in more detail the technical feasibility of constructing and operating a hydro-electricity generation scheme in conjunction with irrigation (at a later stage) using water in or from the Hurunui River below its confluence with the Mandamus River.
- 44 It is hoped that through the agreement, the parties will be able to investigate the opportunities, benefits and synergies that could arise through the construction and operation of such a scheme.
- 45 The details of the scheme have not been finalised but in summary it will consist of the following components:
- 45.1 Water will be diverted from the river at approximately Point A on Appendix 1. The scheme has assumed that any take and diversion will comply with the minimum flow regimes established in Proposed Variation 8 to the Proposed Natural Resources Regional Plan for Canterbury¹. This is a key assumption for the scheme and maintaining this flow regime is likely to be crucial to the future viability of the proposed scheme.
- 45.2 The diversion and intake structure will need to incorporate some means of controlling diverted flows and excluding fish. Diversions systems for these types of size of schemes typically include the use of gravel bars and/or low level weirs to control and direct flows from the river to the intake. These

¹ The flow regime for A permits at SH1 bridge being 15 cumecs from September to January, 12 cumecs from February to March, 15 cumecs for April, 12 cumecs for May to July, and 13 cumecs for August. The flow regime for B permits at the SH1 bridge being 26.7 cumecs from September to January, 23.7 cumecs from February to July, and 24.7 cumecs for August.

types of low level (less than 3 metres) structures are often crucial to accurately managing flow while not acting as a barrier to the movement of gravel down the river and the upstream and downstream migration of fish and other biota. However, I have observed in a number of locations around New Zealand where planning tools designed to prohibit damming of rivers also makes the implementation of these types of structures very difficult. I would request that the panel carefully consider this issue when making any decisions around what activities are prohibited and ensure that it does not preclude this type of structure (as is outlined in the evidence of **Dr Mitchell**).

- 45.3 In a similar manner, while Meridian agree that fish exclusion measures will be necessary for any intake and outfall structure, I request that the panel carefully consider how this requirement is included. There are an increasing number of satisfactory methods to achieving fish exclusion which do not necessarily include the requirement for fine mesh (~3mm) fish screens. I request that any direction from the panel on this issue should allow for other methods which are now being employed around New Zealand. The specific relief being sought by Meridian in relation to this matter is set out in evidence of **Dr Mitchell**.
- 45.4 Diverted water will then flow in a canal through the Balmoral Forest. Energy will be generated by creating "head" via the canal and then dropping the water through a series of power stations. The final layout of the scheme and number of stations is yet to be confirmed. However, work completed to date indicates that up to 97 GWh of energy can be generated on an annual basis at a cost which is competitive with other hydro and wind developments currently under development. **Mr Brown** discusses the benefits of new generation in this region in more detail in his evidence but to help put this in context 97 GWh is sufficient energy for approximately 12,000 households.
- 45.5 The water will then be returned to the river in the vicinity of Point B on Appendix 1.

MITIGATING THE EFFECTS OF HYDRO-ELECTRICITY GENERATION

- 46 At its very simplest, the hydro proposal being considered by the parties is non-consumptive and does not result in a down-stream reduction in the resource. In addition, the proposal does not involve damming the main-stem of the lower Hurunui River. Accordingly, the issues associated with the direct construction of a dam and concerns around matters such as fish passage to the upper river are

not applicable to the current concept proposals. The principal issues will be the reduction in river flow between the intake and outfall (Points A and B on Appendix 1) and any effect this will have on the instream and riparian ecological systems.

- 47 Meridian has a long track record of mitigating the effects of hydro-generation on braided rivers such as the Hurunui River. A good example of this is Project River Recovery which focuses on the restoration of ecological habitat and pest control in the upper Waitaki Catchment. This has been undertaken in association with the Department of Conservation since 1991.
- 48 More recently Meridian has proposed extensive braided river mitigation associated with the proposed North Bank Tunnel project, a tunnel diversion hydro scheme located on the lower Waitaki River. Consents, including the proposed mitigation, have been granted for this scheme by Environment Canterbury although they are now under appeal to the Environment Court (a copy of the decision and consent conditions can be provided on request). Proposed mitigation includes:
- 48.1 Mitigation of braided river birds including habitat enhancement through control of weeds and pest control management;
 - 48.2 Mitigation of in-stream habitat, including periphyton, invertebrate and fish (both native and salmonid) issues through design of an appropriate flow regime for the river; and
 - 48.3 Mitigation of in river and riparian vegetation issues, including wetlands that border the river.
- 49 The scale and type of effects associated with any lower Hurunui River project will be different (and almost certainly smaller) to the North Bank Tunnel project which involves diverting up to 260 cumecs.
- 50 However, in the context of the lower Hurunui River proposal, there are clearly numerous mechanisms that could be implemented to mitigate the effects of hydro-electricity development.
- 51 Meridian has considerable experience in habitat and environmental enhancement through the development and ongoing management of its existing hydro-electricity infrastructure. It would be well placed to provide these skills were they required to be developed as part of lower Hurunui River proposal.

CONCLUSIONS

- 52 My evidence has shown that both Meridian and NTFE believe an important and viable hydro-electric scheme can be developed on the lower Hurunui River. Such a scheme would provide a valuable contribution to meeting New Zealand's increasing demand for electricity in a manner that is consistent with the New Zealand Energy Strategy and national climate change objectives.
- 53 The work completed to date has been based on adopting the minimum flow regime developed by ECan for the lower Hurunui River in Proposed Variation 8 to the PNRRP. As with all hydro developments, scheme viability is highly sensitive to the availability of water. Any increase in minimum flow or similar alterations to the flow regime will reduce the viability of the scheme. I ask that the panel do not potentially preclude this development by adopting a minimum flow regime for the lower Hurunui River that is higher than that proposed by ECan in Proposed Variation 8.
- 54 If a scheme is developed, Meridian can bring considerable expertise to the design of mitigation measures to address any potentially significant effects. The specific nature of these mitigation measures would be dealt with through consent conditions for the scheme. However, I believe that the panel should take note that commissioners for both Meridian and other similar recent hydro applications have accepted that effects on braided rivers can be mitigated.
- 55 I also ask that the panel be mindful of the requirements for river diversion structures and intakes when considering any rules to preclude the construction of dams across the river and the establishment of fish screen standards.

Dated: 31 March 2009

Nicholas Charles Eldred

Appendix One
Schematic Plan of Lower Hurunui Hydro Proposal